TG 142

AEHA

UNITED STATES ARMY ENVIRONMENTAL HYGIENE AGENCY

ABERDEEN PROVING GROUND, MD 21010-5422

MANAGEMENT OF BIRD AND BAT MANURE

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3 DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) Technical Guide No. 142	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION USA Environmental Hygiene Agency 6b. OFFICE SYMBOL (If applicable) HSHB-RP	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code) Aberdeen Proving Ground, MD 21010-5422	7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)
Management of Bird and Bat Manure

12. PERSONAL AUTHOR(S)

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Final	FROM ____ TO ____	85 January	11

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Cryptococcosis, Histoplasmosis, Bird Manure, Bat Manure, Decontamination, Formalin

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The high nutrient content of accumulated bird and bat manure provides an excellent growth medium for the causative organisms of cryptococcosis and histoplasmosis. Disturbing bird and bat manure or the soil it is on can result in human disease. This guide advises of the potential health dangers and outlines the procedures and precautions necessary for safe, effective management of bird and bat manure.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☐ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☒ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL Mr. Brian Zeichner	22b. TELEPHONE (Include Area Code) (301) 671-3792 22c. OFFICE SYMBOL HSHB-RP

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted. All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO ATTENTION OF

HSHB-RP-MG
Technical Guide No. 142

MANAGEMENT OF BIRD AND BAT MANURE

FOREWORD

Accumulation of bird or bat manure inside buildings, under trees near human habitations, or on structures and machinery is undesirable. Bird and bat manure accumulates wherever birds or bats congregrate to loaf (rest) during the day or roost at night (daytime roosting for bats). The manure causes objectionable odors, creates a messy appearance, impedes human activities, and corrodes building surfaces, metals and equipment. It may also harbor disease organisms harmful to humans and domestic animals. This guide advises of the potential health dangers and outlines the procedures and precautions necessary for safe, effective management of bird and bat manure. It also illustrates that cleanup of such manure may be much more difficult than preventing its accumulation.

HSHB-RP-MG
Technical Guide No. 142

January 1985

CONTENTS

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO ATTENTION OF

HSHB-RP-MG
Technical Guide No. 142

January 1985

MANAGEMENT OF BIRD AND BAT MANURE

1. DISEASE ORGANISMS WHICH CAN BE FOUND IN BIRD AND BAT MANURE. The high nutrient content of accumulated bird and bat manure provides an excellent growth medium for organisms of potential human health concern. While this guide primarily addresses the prevention of cryptococcosis and histoplasmosis (the major disease threats of bird and bat manure), personnel should also be aware of the possible danger of psittacosis and rabies (discussed in paragraphs c & d below).

a. Cryptococcosis. Pigeon droppings appear to be the most important source of the fungus Cryptococcus neoformans in the environment. C. neoformans has been found from as many as 84 percent of samples taken from old roosting areas. As many as 50-million colony forming units have been found per gram of pigeon manure. Cryptococcosis is acquired by inhaling yeast-like vegatative cells of the organism. These cells measure 2-3 microns in diameter and are easily airborne. Clinical manifestations of the pulmonary infection are not characteristic and may be absent. The infection can disseminate and result in cryptococcal meningitis (inflamation of the membranes of the brain and spinal cord), which is difficult to diagnose and fatal if not properly treated. Between 1969 and 1978, there was an average of 126 reported deaths per year due to cryptococcal meningitis in the United States. However, since it is a nonreportable disease, the actual number is unknown.

b. Histoplasmosis. The causative agent of histoplasmosis, Histoplasma capsulatum (a mold), is often found in soil that has been enriched by 3 or more years' accumulation of bird droppings. It has also been found in bird and bat droppings not in contact with the soil. Infection is by inhalation of the spores of this fungus which can be carried by wind and dust. Most infections produce no symptoms or only a mild influenza-like illness. However, pneumonia, and even death, from a chronic infection is possible. It has been estimated that annually there are 500,000 infections, 5,000 individuals hospitalized, and 800 deaths in the United States.

c. Psittacosis. A rickettsial-like organism, Chlamydia psittaci, causes psittacosis. Approximately 150 cases are reported annually in the United States. This disease is contracted by inhaling C. psittaci which is found in feathers and droppings from infested birds. Since the organism becomes less infectious with time, active roosts are of greatest concern. While the disease most often occurs in bird handlers, those cleaning up bird excreta could contract the disease as well. Psittacosis is characterized by fever, headaches, and muscle pain, with or without obvious respiratory symptoms. Untreated cases can progress to pneumonia and/or generalized toxemia resulting in death. C. psittaci is 0.35 micron in size, so a respirator with a high

efficiency (hepa) filter capable of filtering particles of 0.3-micron size will protect personnel from inhaling the organism. It is assumed that the decontamination procedures outlined in paragraph 4 would be effective against C. psittaci even though specific laboratory tests have not been undertaken to confirm this.

d. Rabies. Airborne rabies (a rhabdovirus) from bat manure has been contracted only in a cave in Texas where thousands of bats had roosted for many years. The danger of rabies infection by inhalation is slight, but the danger from handling bats is much greater, especially since infected bats may be present during a clean-up operation. Clean-up personnel should be cautioned to handle bats only with nets and gloves.

2. CASE STUDIES OF HISTOPLASMOSIS AND CRYPTOCOCCOSIS. As an example of the infective potential of organisms inhabitating bird and bat manure, four documented cases of human infection are presented.

a. Histoplasmosis Outbreak at an Arkansas Courthouse. The catwalk around an Arkansas courthouse tower was covered with 1-foot of pigeon manure. The manure was shoveled off the roof and allowed to fall 4 stories to the ground. Air conditioners picked up the falling spores and distributed them within the building. Of the 84 employees inside, 52 percent developed fever, cough, chest pain, myalgia and/or laboratory evidence of histoplasmosis. Twenty-four other cases of histoplasmosis occurred among construction workers and people who visited the courthouse; one individual contracted the disease after visiting 10 minutes; of those exposed who escaped illness, 87.5 percent had had previous infections. However, five people with evidence of previous infection became ill, so it is believed that previous infection affords only partial immunity.

b. Histoplasmosis Outbreak due to Disturbing a Bird Roost. The potential for histoplasmosis to disseminate downwind is clearly illustrated by an outbreak that occurred in Iowa when a starling roost was bulldozed. People up to 1-mile away contracted histoplasmosis and the bulldozer operator died after a 7-week illness.

c. Cryptococcosis in a Farm Mechanic. A farm mechanic worked on machinery in a grain-drying building where live pigeons were present. The mechanic developed cryptococcal meningitis and was hospitalized for 8 eight weeks. The pigeon manure from the grain-drying building was found to have 24.4 x 10^6 colony-forming units per gram. While he did recover fully, the costs in lost wages and hospitalization were significant.

d. Problem of Misdiagnosis. Failure to diagnose cryptococcosis can result in fatalities. For example, a 46-year old man tore down a steeple and developed a chronic neurologic syndrome. He was treated for tuberculous meningitis and symptoms went into remission (as they may do for a disseminated infection). One-year later he was hospitalized with chronic inflammatory

disease of the brain coverings and diagnosed as having cryptococcosis. Treatment with amphotericin B and flucytosine failed to save his life.

3. DETERMINATION OF HEALTH HAZARD. Prior to initiating the cleanup of potentially infested material, a determination should be made whether or not the material is infested with H. capsulatum or C. neoformans. Samples should be processed by a laboratory which has had experience culturing such fungi. The Centers for Disease Control (CDC), US Public Health Service, Center for Infectious Diseases, Division of Mycotic Diseases, Atlanta, GA 30333, (404) 329-3126, has such a laboratory and can perform isolations for these organisms on a fee basis ($35 - $50 per sample). The processing laboratory should be contacted prior to sampling to ascertain number of samples, how to take samples, sample submission and other sampling protocol details. The sampling protocol will vary depending on the situation and cannot be detailed here, however, to aid in preliminary planning, a rough outline of sampling procedures is described. Care must be exercised to ensure that a fair representation of the material is collected. Typically, 6-ounce samples are required, ranging from a minimum of 2 per 100-square feet to a maximum of about 40 for areas of 1 acre or more. Each 6-ounce sample should be a composite of material from various locations within the sample site. For example, if one sample is to represent a 50-square foot quadrant, the 6 ounces should be collected from various locations within that sample quadrant. Samples should be placed in clean plastic bags with a separate, sterile tongue depressor or spoon used to collect each sample so that cross contamination does not occur. Each sample should be labeled on the outside of the bag. A map should be prepared indicating the location of the area and sample locations within the area.

4. DECONTAMINATION OF BIRD AND BAT MANURE OR CONTAMINATED SOIL. The removal or disturbance of pathogen-contaminated bird manure, bat manure, or soil contaminated with bird manure can present a health hazard to those doing the work as well as the general population downwind of the operation. The safety of workers and the general population can be assured only by killing the causative agents of human diseases prior to activities which could cause these organisms to become airborne.

a. Selection of Decontaminant. The CDC recommends the use of formalin solutions for killing all viable stages of H. capsulatum and C. neoformans. To date, formalin is the only material which has been proven through laboratory analysis and field experience to effectively kill these pathogens in the environment. Formalin not only kills on contact, it also evaporates, penetrating cracks and crevices, thus reaching areas which may not have otherwise been contacted. At this time, formalin is the decontaminant of choice.

b. Use of Formalin to Decontaminate Manure or Soil.

(1) Formulation of Disinfectant. In order to be effective, the formalin solution must completely saturate the material being decontaminated. Use a 5-percent formalin solution, by volume. This is generally prepared from a commercially available formaldehyde solution which contains 37-40 percent by weight, formaldehyde gas in water, stabilized with 10-15 percent methanol.

(2) Disinfection of Soil. Pathogenic organisms have been recovered from a soil depth of 6-8 inches. Therefore, if soil is contaminated with H. capsulatum, it should be saturated with formalin to this depth.

(3) Environmental Temperature Considerations. Decontamination should be conducted when the temperature of the air or material being decontaminated is between 60° F and 90° F. Formalin is less effective at temperatures outside of this range.

(4) Disinfection of Building Surfaces. The most effective formalin saturation of infected material occurs if the formalin is applied in three separate applications. In areas where the accumulation of bird manure is shallow, formalin should be applied on 3-successive days. Where bird manure is deep, application of the formalin should be done on alternate days to enhance the probability of contact with all infected material. It may be necessary to turn, probe, or aerate the material between the second and third applications to gain complete saturation. Any manipulation of the infected material must be done in a manner which will liberate as few organisms into the air as possible. Spraying formalin during the manipulation will help to limit the number of viable organisms which may become airborne and may increase saturation as well. Even building surfaces with very little or no bird manure visible may be contaminated and should, therefore, be treated. Disinfect contaminated equipment by soaking in 5-percent formalin for 15 minutes.

(5) Rates of Application. The CDC recommends the following rates of application of 5-percent formalin, one-third of these amounts to be applied during each of three treatments: vertical walls (1 gallon per 150-square feet); horizontal surfaces, other than when bird manure is on soil (1 gallon per 6-square feet); bird manure on soil (1 gallon per 1-square foot). It is important to realize that these quantities are guidelines. The proper amount of formalin to use is that quantity which completely saturates the contaminated material, and this will vary depending on the situation; however, care must be exercised to avoid formalin runoff.

(6) Determining Decontamination Effectiveness. Generally, evaporation and inactivation of formalin occurs in 2-4 days. Prior to physically collecting and disposing of the manure, it is good practice to collect samples and have them retested to make sure that the decontamination was effective. However, if decontaminated pigeon manure is reinoculated with

C. neoformans, the organism could possibly recolonize the material before laboratory results were received. Therefore, if there is confidence that decontamination was done correctly and birds cannot be excluded from the manure, it would be best to dispose of the manure promptly rather than waiting for the completion of laboratory tests to confirm that decontamination was successful. H. capsulatum can also reinfest decontaminated soil if the bird roost is not removed. However, the rate with which decontaminated soil is typically reinfested is slow enough to allow for testing of the soil to determine the effectiveness of the decontamination procedures. In order to insure that all the formalin has dissipated, wait for 1 week after the last formalin application before taking post treatment samples.

(7) Disposal. After decontamination with formalin solution, the manure may be disposed of in a sanitary landfill. Soil which has been treated is not permanently sterilized and normal vegetation and microrganisms will recolonize the area.

5. PROTECTION OF WORKERS FROM FORMALDEHYDE AND INFECTIVE ORGANISMS. Consultation should be made with an industrial hygienist prior to disturbing manure deposits for advice on matters of personnel safety such as protective clothing and the proper selection, use, and fitting of respirators.

a. Protection During Decontamination.

(1) The National Institute for Occupational Safety and Health (NIOSH) recommends that "formaldehyde be handled in the workplace as a potential occupational carcinogen" and that "as a prudent public health measure, engineering controls and stringent work practices be employed to reduce occupational exposure to the lowest feasible limit," (Appendix, reference 4). Formaldehyde vapor is intensely irritating to the eyes, nose, and throat. It may cause skin irritation and is harmful if swallowed.

(2) To protect against contamination, wear formalin-impervious hat, coat, pants, boots, and gloves. Immediately remove nonimpervious clothing that becomes contaminated. Wash immediately when skin becomes contaminated. Provide a quick drench eyewash at the work site. An industrial hygienist should be contacted to determine formalin breathing zone concentrations so appropriate respirator selection may be made. For breathing zone concentrations which do not exceed 30-parts per million (ppm) formaldehyde, a full face piece chemical cartridge respirator with a formaldehyde cartridge(s) and high efficiency filter(s) capable of excluding particles of 0.3-micron size may be used. For concentrations up to 50 ppm, provide one of the following: a gas mask with an organic vapor canister and filter capable of excluding particles of 0.3-micron size; or a supplied air respirator with a full face piece. For breathing zone concentrations greater than 50 ppm formaldehyde, provide a type C supplied air respirator with a full face piece operated in

pressure-demand or other positive pressure mode or with a full face piece, helmet, or hood, operated in continuous-flow mode (Appendix, reference 3).

b. Protection During Final Cleanup. When collecting the bird manure for final disposal, it would be prudent to wear protective clothing and equipment to protect against the possibility that decontamination was not completely successful, or the possibility that formalin is still present. If formalin is present in quantities which could wet garments, formalin-impervious clothing must be worn. If formalin is not present, disposable coveralls, boots, and hats may be worn to protect from contamination of personal clothing with infective organisms. After work, remove protective clothing at the work site prior to removing respirator protection. If considered contaminated with disease agents, dispose of clothing as an infectious waste.

6. SELECTION OF PERSONNEL FOR DECONTAMINATION AND CLEANUP.

a. Selection of Disease-Resistant Individuals.

(1) Personnel who have had histoplasmosis and have recovered are less likely to contract this disease. Therefore, such individuals, if available, should be selected for the job. Skin testing for H. capsulatum is recommended for screening, with positive tests indicating active immunity in healthy workers. Histoplasmin antigen is available for skin testing and provides reliable identification of individuals who have had past infection. In addition, since skin testing usually becomes positive about 14-21 days following inhalation of H. capsulatum, skin testing is also useful as a diagnostic tool. Blood serology titers are not more sensitive than skin testing. Therefore, blood serology should not be used as a screening tool.

(2) No screening test for immunity to C. neoformans is available. Serodiagnostic tests for cryptococcal antigen, using slide latex agglutination (SLA) studies and tube agglutination testing for antibody titers are available at this time. The SLA and tube agglutination should only be used as a diagnostic tool to access infectivity of individuals.

(3) The best technique to prevent infection with H. capsulatum or C. neoformans is to provide proper respiratory protection to exposed workers and to properly deactivate the organism as described.

b. Selection of Healthy Individuals.

(1) Preplacement evaluation should be performed on all individuals who are selected in bird and bat manure decontamination and clean-up work crews to determine if they have increased susceptibility. A history and physical exam should be performed with attention to cancer, immuno deficiences, steroid therapy, pulmonary disease, and diabetes mellitus.

(2) Workers should be selected who are physically and psychologically able to perform their work while wearing the prescribed respiratory protection. As a minimum, preplacement respiratory examinations should include the determination of the forced expiratory volume in 1 second and forced vital capacity (TB Med 502, para 2-10).

7. TECHNICAL ASSISTANCE. Technical advice may be obtained by telephone from this Agency; Pest Management and Pesticide Monitoring Division, AUTOVON 584-3792, commercial (301) 671-3792; Occupational and Environmental Medicine Division, AUTOVON 584-2714; or Industrial Hygiene Division, AUTOVON 584-3118. Requests for services should be directed through appropriate command channels of the requesting activity to the Commander, US Army Environmental Hygiene Agency, ATTN: HSHB-RP, Aberdeen Proving Ground, MD 21010-5422, with an information copy furnished the Commander, US Army Health Services Command, ATTN: HSCL-P, Fort Sam Houston, TX 78234-6000.

APPENDIX

REFERENCES

1. TB MED 502, 15 February 1982, Respiratory Protection Program.

2. Centers for Disease Control (CDC), Pamphlet, Environmental Control of Pathogenic Fungi, In press.

3. Pocket Guide to Chemical Hazards, September 1978, National Institute for Occupational Safety and Health/Occupational Safety and Health Administration, DHEW (NIOSH) Publication No. 78-210, GPO Stock No. 017-033-00342-4.

4. Coene, R. F.; National Institute for Occupational Safety and Health, "FORMALDEHYDE: Evidence of Carcinogenicity," Current Intelligence Bulletin 34, U.S. Department of Health and Human Services, 15 p, 15 April 1981.

5. Dean, Andrew G.; Bates, Joseph H.; Sorrels, Callie; Germany, William; Ajello, Libero; Kaufman, Leo; McGrew, Charles; and Fitts, Augusta; An Outbreak of Histoplasmosis at an Arkansas Courthouse, with five cases of Probable Reinfection; American Journal of Epidemiology, Vol 108 No. 1, 1978.

6. DeSalvo, Arthur F.; ed; Occupational Mycosis. Lea and Febiger: Philadelphia, PA, 247 p, 1983.

7. Fiennes, R.; Zoonosis and the Origins and Ecology of Human Disease. Academic Press: London, 1978.

8. Hoeprich, P., ed; Infectious Diseases, 2nd edition, Harper and Row: Hagerstown, 1977.

9. Hubbert, William; McCulloch, William; and Schnurrenberger, Paul, ed.; Diseases Transmitted from Animals to Man, 6th edition, Thomas: Springfield, 1975.

10. Lucid, Vincent J. and Slack, Roy S.; Handbook on Bird Management and Control, Directorate of Environmental Planning, Air Force Engineering Services Center, Tyndall Air Force Base, FL 32403, p. 185, March 1980.

11. Tosh, Fred E.; Dato, Irene L.; D'Alessio, Donn J.; Medenos, Artone A.; Hendricks, Stanley L.; and Chin, Tom D.Y.; The Second of Two Epidemics of Histoplasmosis Resulting From Work on the Same Starling Roost; American Review of Respiratory Diseases, Vol 94, p 406-413, 1966.

12. White, Paul D.; Kaufman Leo; Weeks, Robert J.; Jones, Mack D.; Hotz, James A.; Cryptococcal Meningitis: A Case Report and Epidemiology Study; Journal of the Medical Association of Georgia, Vol 71, August 1982.